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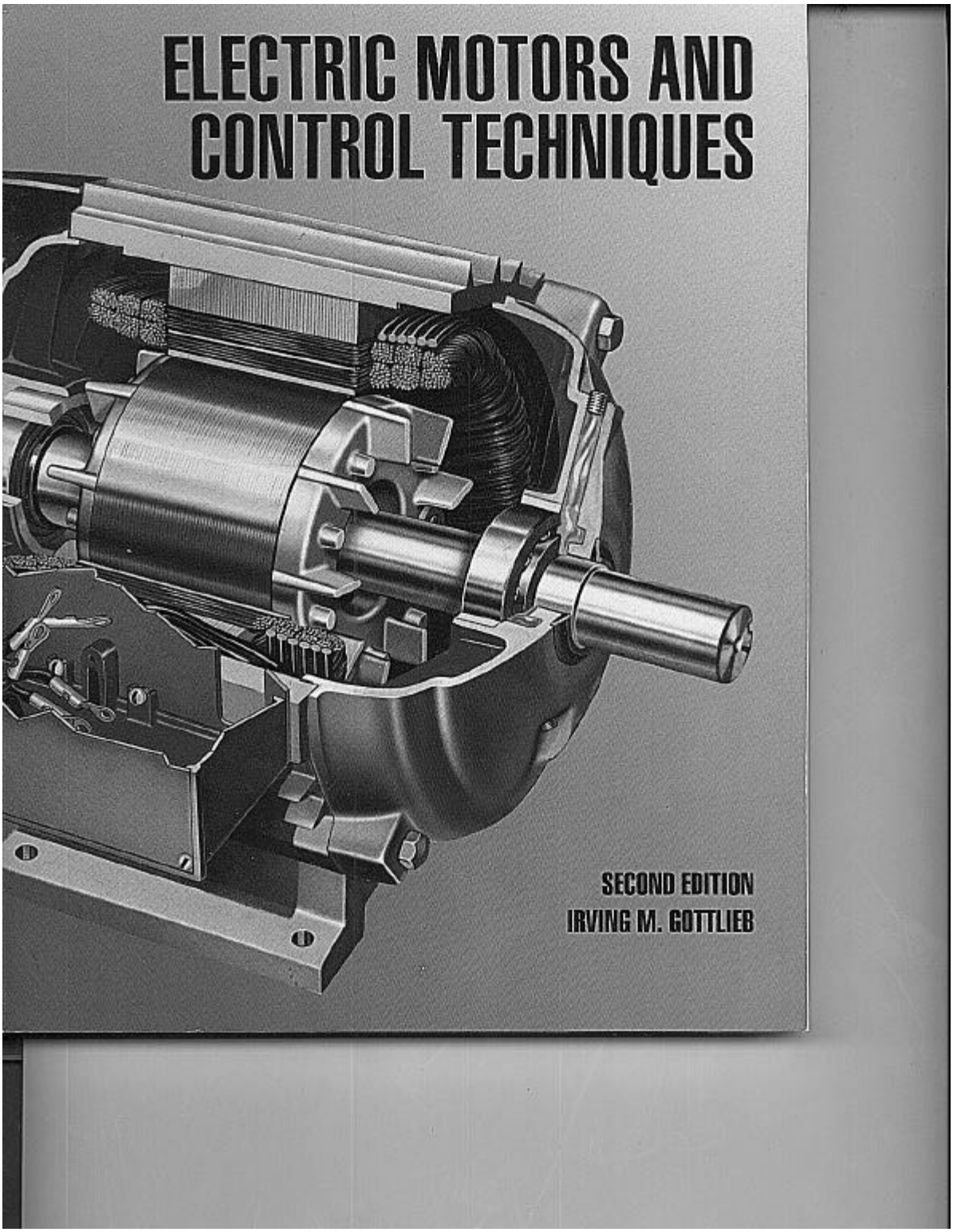

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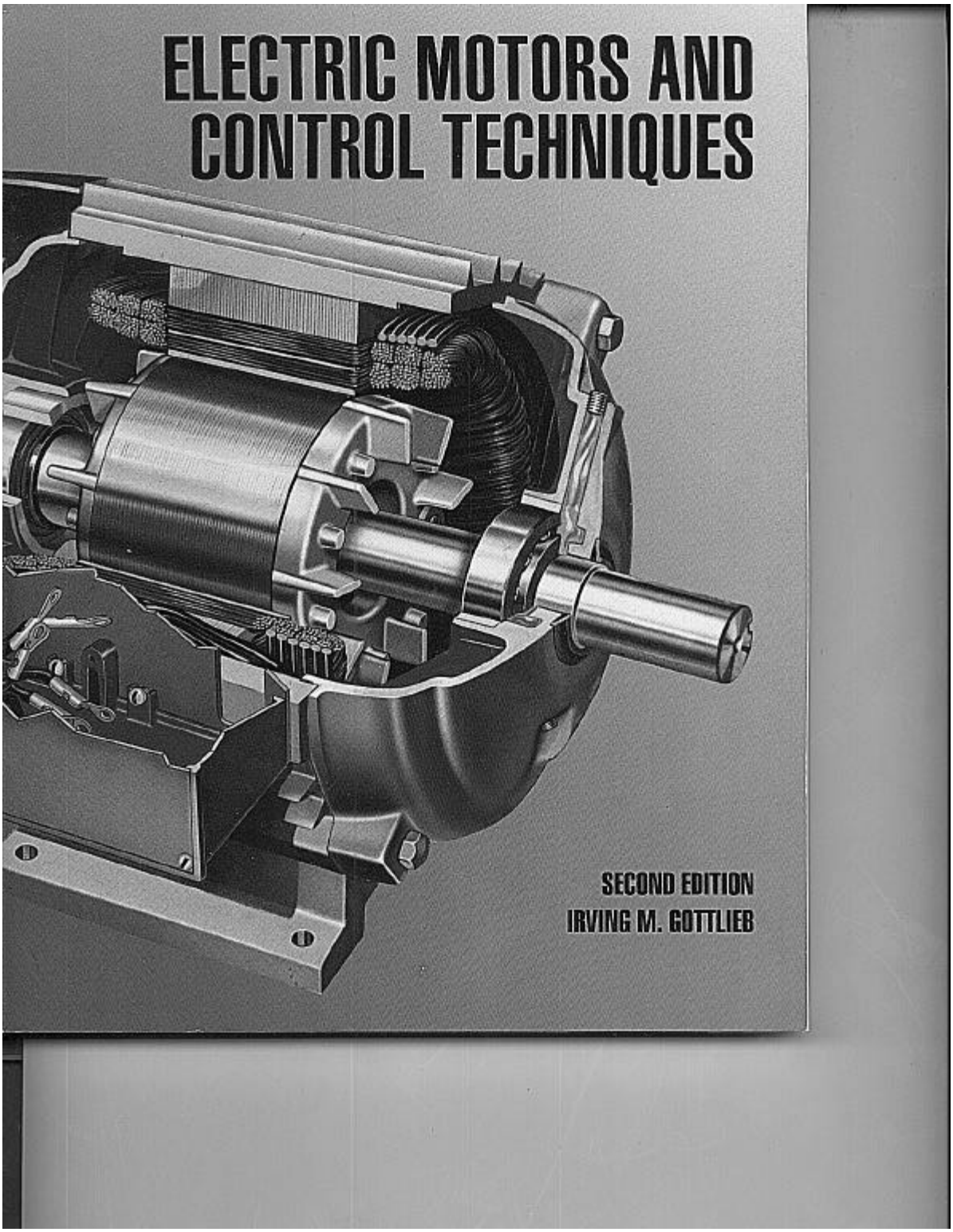

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Introduction

FROM SHIPS TO TOYS, FROM STEEL MILLS TO PHONOGRAPHS, AND WHEREVER ELECTRICAL energy has teamed with mechanical motion, the impact of solid-state electronic control of electric motors has made itself felt. It is true that antennas were rotated, tools were driven, and vehicles were electrically powered prior to the advent of thyristors, power transistors, and sophisticated integrated-circuit modules. However, the improvements in precision, flexibility, reliability, and controllability have been so great with the new devices and techniques, that we find ourselves involved with a new and fascinating aspect of technology.

Electric motors, generators, and alternators (the so-called "dynamos" of yester-year) assumed their roles as industrial "workhorses" during the latter portion of the previous century and the early part of this century. Surprisingly, a perusal of texts dating that far back can still yield useful information about starting, stopping, reversing, and stabilizing such machines. But continued reliance on these venerable methods can only lead to technical obsolescence of machines and techniques. A new era of motor control exerts new demands and, at the same time, stimulates new challenges and provides new opportunities.

When both power engineering and electronics were still in their early stages, those with bold imaginations perceived the potential benefits that might result from a merger of the two arts. A formidable deterrent to such mutuality between these two electrical disciplines was the unreliability of then-available electronic devices and components. During the 1930 to 1950 interim, the electronic control of motors did make some headway as better tubes and components became available for such applications. In particular, *thyratrons* and *ignitrons* attained popularity. It became feasible to electronically control the speed of fractional-horsepower machines and, to some extent, larger integral-horsepower machines. Significantly, some of these circuit techniques are clearly recognizable as the predecessors of present-day solidstate controllers.

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This obviously brings us to the solid-state chapter of electronic evolution. Initially, the invention of the transistor sparked a number of application efforts. With the soon-to-follow development of power transistors, the direct control of larger electromagnetic devices became possible. Also, the introduction and quick commercialization of thyristors enabled the precise and efficient control of very large motors. Now, a plethora of solid-state devices have become available for arriving a wide range of motor types and sizes; these include silicon NPN and PNP power transistors, N and P channel power MOSFETs, power Darlingtons, germanium power transistors, IGBTs, GTOs, MCTs, and power op amps.

So much for the muscles for motor-control systems. Fortunately, technological-evolution has also provided us with the brains to actuate these muscles in coordinated precision. No end of dedicated ICs have been developed to time, automate, manipulate, and protect these motor-control systems. Both analog and digital techniques are used; excellent control and regulation of motor operational-parameters can be realized without extensive development-projects, or wasteful cut-and-try activities.

The motors, too, have participated in this evolution. The traditional motor-formats, although remaining useful, have to a considerable extent given way to types relying less upon mechanical commutation or conventional single or polyphase power, but much more upon timed-pulses from the alluded "brainy" control-ICs. Such motors exhibit attributes of the long-enduring de and ac motors, but also possess unique advantages of cost, reliability, and controllability.

The foregoing matters lead very naturally to the final chapter of the treatise dealing with electrically-powered automobiles. Therein, I endeavor to resolve some of the controversies that have long plagued this area of electric-motor application. Interestingly, all of the preceding chapters bear relevancy. The propulsion of the electric auto can be provided by dc or ac motors, and by traditional or new-age motor formats. This stems from the versatility of the aforementioned dedicated control-ICs.

Regardless of specific areas of interest, if you are technically-inclined, you should find useful guidance to practical implementations of electric motors and their control, but I hope that this book will also stimulate rewarding, experimentation and creativity.

The following individuals and firms deserve thanks for their assistance and for their contributions of electronic-control circuits and systems for electric motors: Michael Apcar, President, Randtronics, Inc.; Michael P. Brown, President, ELECTRO AUTOMOTIVE; W.C. Caldwell, Distributor Sales Administrator, Delco Electronics; Walter B. Dennen, Manager, News and Information, RCA; Robert C. Dobkins, Manager of Advanced Circuit Development, National Semiconductor Corp.; Norbert J. Ertel, Marketing Analyst, Bodine Electric Co.; Forest B. Golden, Consulting Application Engineer, General Electric Co.; Alan B. Grebene, Vice President, Exar Integrated Systems, Inc.; Frank A. Leachman, Media Manager, Superior Electric Co.; Larry Steckler, Editor-in-Chief & Publisher, Gernsback Publications, Inc.; Lothar Stern, Manager, Technical Information Center, Motorola Semiconductor Products, Inc.

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